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**GAS #450**

**A Space Payload for the People  
Central Coast Student Experimenters**

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## GAS #450

### A Space Payload for the People.

**Abstract:** The purpose of this paper is to describe the GAS Payload #450. This discussion includes the peoples' efforts, the experiments, lessons learned, and a few powerful positive steps toward community involvement. The following is a list of experiment titles: "Guppies in Space," "Electrophoresis of Enzymes in Microgravity," "Diffusion of Ions in Solution," "Space Cement," "Bubbles in Space," "Small Particle Studies," and "Liquid Separation in Microgravity."

**History:** To better understand the background of this payload, the following information and philosophy are presented. The American Institute of Aeronautics and Astronautics (AIAA) founded the GAS project to encourage community involvement directly with the civilian space program, and to strengthen local relations between people and significant civil aerospace entity at the Vandenberg Western Space Center. A request for proposals was issued to the Central Pacific Schools District, including intermediate, high schools and colleges, as the payload social purpose is to provide the people of the Central Coast an avenue through which they could become involved with the space program. The above request thereby challenged the youth within the educational system to "get active in life, in space." The path is positive, fulfilling and fun! We finished the first draft of the PAR just prior to the Challenger incident. All experimenters achieved significant progress as demonstrated through maturing breadboard experimental hardware. Several experimental groups have already developed flight hardware prototypes. Post-Challenger, the first PAR telecon was actualized. The Safety Data Package has been outlined and is in work. The prototype payload chassis has been fabricated in order to define detail integration ideas and concerns. These latest efforts are specially significant in the current political atmosphere of weakly defined space program direction as influenced by the current administration. There is positive progress in work going on out here in the real world! The progress is directed towards healthy fulfillment in life goals by a direct practice into the art of engineering as defined by: the process of manifesting an idea or dream into three-dimensional first person realities. The history aspects would not be complete without mention of NASA GSFC's Special Payloads Division and endless support, enthusiasm and patience. Their dedication to the advancement of science and self is role-modeled by these people in their support of our diminutive and austere projects.

**People Considerations:** As the GAS 450 project is as much an effort of human exploration and fulfillment as it is one of data return, the people factor is discussed as follows: At the heart of the project are the student experimenters. These people are full of the stuff of youth and eager for directions in which to channel their energies. Our society at large does not provide adequate role models or opportunities for young folks to challenge or apply themselves to. The media—TV, radio, and periodicals, etc., see these young believers as consumers to exploit, rather than the ambassadors and creators of our collective future, in these times of conservative protectionism and space budgets on directive of the administration. It's difficult for anyone to channel energy into such an idealistic and abstract direction as space exploration. The human's innate desires to reach outwards into the nebuloities of near and far space are stymied by the global noise of increased profits, greed, and power. The resultant imbalance of wealth, hunger, and sickness require an inordinant amount of human energy and effort to counter. The humanistic efforts are ongoing, if only the insensitive and abusive causal factors' price of the waste rather than the precious overtaxed resources of the human conscious. It's not to dwell on the obvious planetary disuse and inhumanitarianism dealt by the powerful few, rather, to the cause of encouraging and rallying the positive energies of those who desire pursuit of the subtle paths, civil space sciences and research. The GAS opportunity, in our case, has provided upwards and hundreds of people of all sorts, an avenue to apply their creative energy into their own tenuous wisp of space research, supposedly available only to the degreed and opportune. The path is good, as evidenced by psychic enrichment and fulfillment of those who've participated in the effort. Smiles everywhere, as supplies of abundant energy, timeliness accomplished despite all sorts of different obstacles and pitfalls. Always the positive, upbeat attitude; the

"can do" outlook!

Even now, a year and a half since Challenger, the GAS symposium is ongoing. A rally point to us, the advisors, and to our young charges. The students and advisors look to us for guidance of outlook, we look to Goddard and NASA. Admittedly, the last eighteen months have been rough as well out here on the Pacific Coast. An electrical integrated test was scheduled for May 1987, to which no response was received. But then again, ego and batteries needed to be charged, as well. The experimenters' purpose in this GAS is for the people. Discovery is scheduled for summer of 1988. New potential is arriving into the middle and high schools, as our veteran seniors now are into the "real" world where survival demands energy and free time is indeed a luxury. So we, the GAS organizers are building fresh presentations for the freshmen, the new and non-initiated, the underclass of young women and men. To again rekindle efforts of meeting after school for fun and learning. To discover what's been built previously, how to fit components into smaller spaces, use less power. To re-emphasize safety concerns, improved means of simply reacting loads, prevention of short circuit potentials; heaps of work left to perform. The human potential is here, in all people. These students of life who elect to work the GAS project, they haven't yet learned to turn themselves off, to say "I can't build spaceships. That's only for science fiction and the military." These youngsters of all ages are doing work at lunch, after school, over the weekend, because they know a chance exists for their handiwork to fly in space, to create an original datapoint for personkind and science, and most importantly of all, to make an idea real, to be in life rather than watch it go by!

The current focus is to regain the creative momentum of the experiments and support people's paths after the summer vacation. Visits to each of the schools are necessary to expose the new and returning to the projects. Information on GAS 450 status as well as the ongoing shuttle recovery are necessary to provide an overall picture. This is required so personal decisions can be made regarding levels of commitment. The most encouraging news we have was that delivered at the 1986 symposium by Dr. Noel Hinners. His statements with regard to ongoing shuttle flights of GAS cans as secondary payloads despite lack of mention on the official manifest, is most encouraging. Mention of space station cans with experimenter visits on orbit are the most tremendous hope generator we have today. The kids', the adults' eyes and imaginations ignite with creativity upon learning of this incredible opportunity. All this energy needs focusing into our current efforts to get the first Central Coast student payload into orbit.

GAS 450 Project Organization: Each of the experiments has a faculty advisor who coaches and counsels the student experimenters. The advisors provide their individual experience and expertise. These contributions fine-tune the student's learning experiences, through solving problems, i.e., battery power usage and distribution, experiment control and design and fabrication, chassis design and fab and fab and refab, etc. . . We found we could develop and improve the designs endlessly. We only began to finalize our designs as the PAR approval became eminent. The Challenger accident gave us a new opportunity to continue to develop our ideas, and regroup, and find new people to fill the opening made by those graduating and leaving the area.

Schedule Organization: One of the guided objectives is to provide the students with an experience similar to the aerospace industries at large. Meeting organization, action item discipline, and schedule milestones processes are utilized to enhance the aura about the project. The following development schedule (see fig. 1) was overlayed on the standard Goddard template in order to pace our work. This has proven very helpful both in getting milestones accomplished and ideas actualized, thereby providing a rare experience for the practice of skills required of these future pioneers of humane research and life. The pacing schedules and commitment to go ahead with the idea developing are determined through a group consensus process. Plenty of meetings get a lot of work done for this group. Communicating both at their respective labs, or collectively at the marathon work meetings, enhances the learning process. The ideas come fast with these young, unencumbered minds, fueled with creating energy, imagination and fired by the glorious feedback of reinforcement provided by building and creating space hardware.

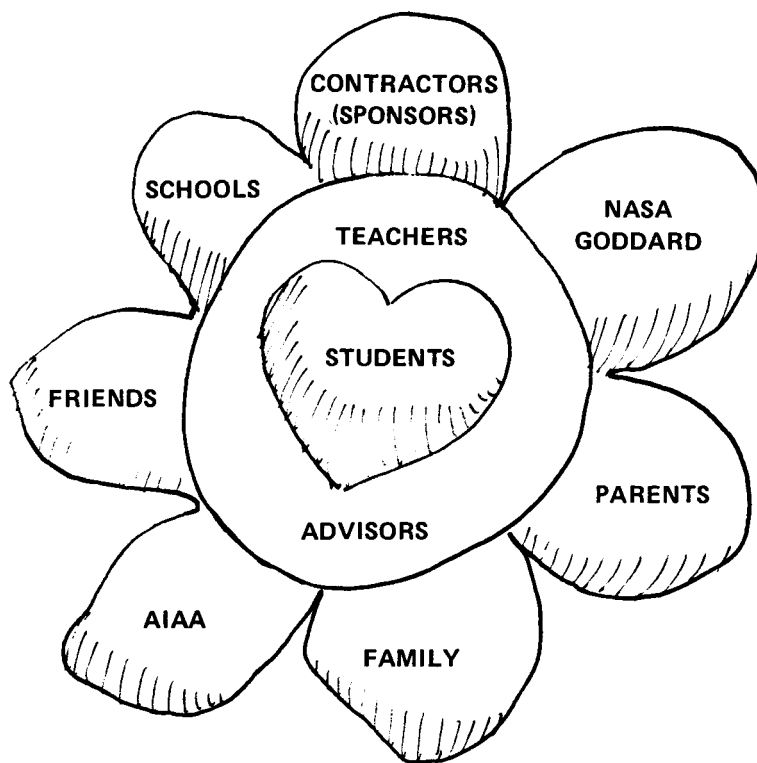


Fig. 1 ORGANIZATION CHART

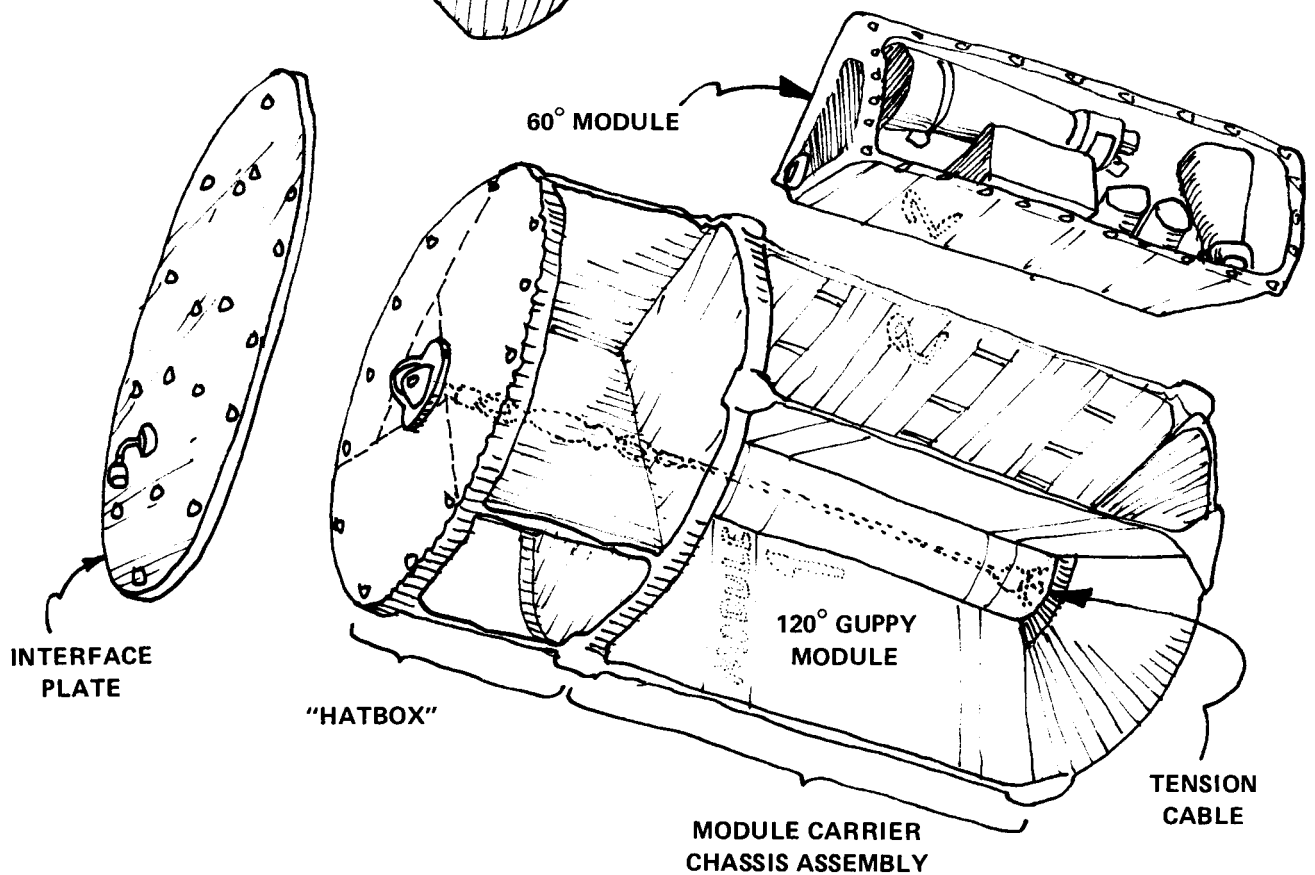


Fig. 2 PAYLOAD CHASSIS LAYOUT

Canister Chassis Design: The AIAA group sponsoring this canister intends to continue flying payloads after GAS 450. The chassis design was fashioned in a modular manner to accommodate experimental requirements and keep technical and fabrication hurdles to a minimum for follow-on flights. A fabrication prototype of the current design has been built. We have six experimenter groups with developmental hardware in work. Getting six experimenters and their support system into the limited confines of a canister is interesting at best. The volume had to be divided evenly. Ready access to the experiment apparatus was a primary parameter. A segmented approach was chosen rather than vertical stacking to keep chassis assembly to a minimum should the need arise to remove and replace components or replenish material, especially towards the canister center. The fabrication prototype was built to provide a module target volume to work towards, and to provide a start point for the chassis which will carry the experiment modules.

Atop the module carrier assembly is the "hatbox" area, a utility area used for battery storage, controller, heater and miscellaneous volume demands. Demands which start out being miscellaneous, get real "too fast." For example, the power to heat the guppy experiment is provided by batteries. These batteries will fill the bulk of the hatbox volume. The power required to heat an experiment for seven days on orbit added to the surprise. To accommodate the experimental requirements of running circulation pumps for 60 days prior to launch plus 7 days on orbit; cement mixers; provide electrolysis current, electrophoresis current, and provide power to keep guppies warm. The first battery size estimate using energy densities available to our budget, indicated we need a battery the size of Volkswagen bug! We've since modified the plan, and will continue to minimize power consumption. The guppies' circulation pumps now run only to circulate oxygen and nutrients as required. The bulk of the experiments will be performed before a canister cold sinks below the experimenters' operational temperature, saving heaps of heater power for on-orbit use. So what if the experimenters chill out as long as the experimental reaction occurred while still warm and the data safely stored! We'll continue to improve and optimize until the PAR and Safety Data Package are signed and we're closed out for flight operations.

The Experiments: Payload G-450 is a multidisciplinary package composed of five self-contained experimental modules. Six experiments have been developed by California Central Coast School students. The scientific objectives are as follows:

Module 1 – "Guppies in Space," Arroyo Grande High School. The experimental objective is to demonstrate a closed loop biological system. Judicious use of insulation in concert with heaters and pumps will sustain several *Lebisticus Reticulatis* species during their passage into LEO. This module will perform intermittent self-operation once sealed into the canister. Water flora will oxygenate the system for the specimens. Heaters will be cycled on orbit to maintain survivable temperatures. General hypothesis research regarding microgravity adaptation to include: 1. *Lebisticus* orientation mechanism with light source as a reference; 2. *Lebisticus* reaction to launch in a fluid environment; 3. Effects upon gestation and birth; 4. Reintroduction to gravity in a fluid environment; 5) Closed cycle life support utilizing photosynthesis; 7. Physiological consequences of short-term exposure to microgravity.

Module 2 – "Electrophoresis of enzymes in microgravity", Cuesta College. A commercially developed electrophoresis device, modified for experimenter peculiarities, is being flown to establish microgravity effects on enzyme migration. The package will be thermally conditioned prior to plate activation.

Module 3 – "Space Cement," Dunn School. The objective of this experiment is to mix and cast a batch of cement in microgravity. A liquid will be introduced into a specimen chamber containing dry cement. A mixer will stir the liquid and cement into a homogeneous slurry, and the mixer withdrawn. The cement can now solidify into a near net shape for materials analysis. The grain structure and material properties will be compared with a control sample prepared on planet.

Module 4 – “Bubbles in Space” and “Space Adhesives,” San Luis Obispo School/Atascadero School. The objective is to study the process of electrode occlusion during electrolysis in microgravity. Current will pass through the various solutions via electrodes. As the solution is electrolyzed the resultant gas will deposit on the electrodes. The gas will occlude the electrode thereby shutting down the reaction. Data recorded will be amperage, voltage, and time. Space adhesives will compare strengths of adhesives bonded in microgravity with a gravity bound sample. Several adhesives will bond various materials, i.e., brass, steel, copper, aluminum. Adhesive grain structure and bond strength are principal objectives of the study.

Module 5 – “Fluid Separation and Small Particles,” Orcutt Schools and AIAA combined module. The objective is to study separation of fluids with varied specific gravities under the influence of microgravity. A timer-activated camera will record separation/mixing of fluids. “Small Particle Studies”: this experiment will sample small atomic particles occurring within the shuttle’s orbital region. A scintillator type device will be utilized as the primary sample detector. The units consist of a hollow cone with sensitive detectors at the cone apex. As the short-lived, high-energy particles pass through the payload bay and the cones, any cone transit will generate a microflash by the doped inner surface of the cone. Count data from the detectors and clock information will be stored for reduction upon deorbit. The hypothesis utilizes the earth’s magnetospheric interaction with the solar wind as a natural high energy particle generator.

Conclusion: If the reader feels interest, energy, and positiveness; and activity has been emphasized through the course of this paper, Good! Another significant purpose is that attitude concept of: “Furthering the humanities cause.” Life and appreciation of the planet as a whole, is one of the prime directors.

The Goddard-provided GAS opportunity is a tremendous, enlightening avenue to practice idea actualization and further the scientific human cause. Sincere thanks to the Goddard Special Projects Office. It is opportunities such as these, which entice young scientific minds from traditional “gravity bounded” roles. May these neophyte experiments continue to fly, and pioneer fresh, creative thoughts!